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PHYSICAL CHEMISTRY.—*Methods of stating acidity.*[1] EDGAR T. WHERRY and ELLIOT Q. ADAMS, Bureau of Chemistry.

Both concentration and potential methods are in general use for stating effective acidity and alkalinity. In the former the quantity (more precisely, the concentration in gram-mols. per liter) of hydrogen ion, in the latter the logarithm of the reciprocal of this quantity, are given. The concentration method is easier to understand, as is brought out by table 1.

TABLE 1

COMPARISON OF METHODS OF STATING ACIDITY

Starting at normality:	Solution 1	Solution 2
Concentration methods		
Actual number	0.0004	0.000 0002
Power of 10 with coefficient	0.4×10^{-3}	0.2×10^{-6}
Power of 10	$10^{-3.4}$	$10^{-6.7}$
Potential method		
P_H: exponent of preceding	3.4	6.7
Starting at neutrality:		
Potential method		
X_H: 7 − P_H	3.6	0.3
Concentration methods		
Power of 10	$10^{3.6}$	$10^{0.3}$
Actual number (specific acidity)	4000	2

In this table is shown the way two values selected at random appear under various methods; the first solution contains 2000 times as much acid as does the second. The method used in the last line obviously brings out their relative acidity with the minimum of calculation on the part of the reader, and may be recommended to writers who wish to make their data readily comprehensible.

[1] Before transmitting this article for publication, it was submitted by the writers to Dr. WM. MANSFIELD CLARK for reply or discussion, and his comments on the subject are contained in the article following this one. The discussion is closed by a brief note by WHERRY and ADAMS. Received February 2, 1921.

The usefulness of methods in which computation begins at the neutral point has been urged by several writers[2] and the "X_H" and "specific acidity" methods are the result of carrying such methods to their logical conclusion. The P_H values are subtracted from 7, and the resulting values are called X_H, or chemical potentials. When X_H is negative, X_{OH}, which is equal to $-X_H$, may be used instead.

The number 7 is the exponent of the hydrogen-ion concentration of pure, neutral water, and represents the average of the values of this constant which have been obtained by some 15 different investigators, at 25°. Even though not absolutely exact, it may be conveniently taken as the standard of reference.

Correspondingly, to obtain the new concentration values, on the acid side divide the usual hydrogen-ion concentration by 10^{-7} or 0.000 000 1; and on the alkaline side divide in the reverse direction. The resulting values, since they are referred to water as a standard, may be called, respectively, specific acidities and specific alkalinities.

In a recent work,[3] W. M. Clark has raised certain objections to methods in which computation begins at the neutral point, which may well be answered here. For simplicity, only the respective potential methods, X_H and P_H, will be discussed, although the arguments apply equally well to the concentration methods.

(*1*) The X_H method does, while the P_H (or pH) method does not, "involve any assumption regarding the nature of that pure water which is never used, [and] which seldom is considered in calculations....."

(*Ans.*) The X_H method does not, while the P_H method does, involve assumptions as to the nature and the hydrogen-ion concentration of a hypothetical acid which is completely ionized in normal solution. Such an acid is at least as imaginary as is pure water, and its hydrogen-ion concentration is known with at best no greater certainty. Moreover, on the alkaline side, the P_H method *does* involve the data for pure water; for the dissociation constants of bases are expressed (however measured) in terms of OH^- concentration, and by definition pure water contains equivalent amounts of H^+ and OH^-; any discrepancy, therefore, between the H^+ and OH^- scales will be halved in the X_H method, whereas the entire error is referred to the range of alkaline solutions by the P_H method. The facts that the hydrogen-

[2] WALKER and KAY, Journ. Soc. Chem. Ind. **31**: 1013. 1912; HENDERSON, Science **46**: 73. 1917; WHERRY, This JOURNAL **6**: 675. 1916; **8**: 591. 1918; and **9**: 305. 1919; TILLMANS, Zeitschr. Nahr. Genussm. **38**: 1. 1919.

[3] *The determination of hydrogen ions*, p. 28. Williams and Wilkins Co., Baltimore, 1920.

ion concentration of pure water is not exactly known, and that it varies with the temperature, need introduce no difficulty, just as in our measuring of lengths it is not a vital matter that the meter is not an exact fraction of the earth's circumference.

(*2*) The X_H values are not, while the P_H values are, "directly derived from the potential of the normal hydrogen electrode."

(*Ans.*) Measurements are actually made against a half-cell, such as the calomel electrode, whose potential in the scale used, whether P_H or X_H, must be independently determined in any case. The factor by which the results of measurement must be multiplied is the same in both.

(*3*) Factory workmen can gain a correct picture of the relation of P_H values to a given process and are not bothered by the fact that the scale runs in the reverse direction from those in everyday use.

(*Ans.*) People of even greater intelligence than the average workman can be taught to use the Baumé hydrometer scale, the Wedgwood pottery-temperature scale, and other empirical atrocities.

(*4*) "Quantities of important data are already recorded in terms of pH....." "To have two scales with numerical values so similar might produce a confusion....."

(*Ans.*) If this sort of consideration had been taken seriously in the past, we should still be using Siemens mercury units of electrical resistance instead of ohms; Dalton's instead of Berzelius's symbols for the chemical elements; and element symbols which would represent the jumble of equivalent and atomic proportions current before the time of Cannizzaro.

Finally, this fact may be emphasized: Only if the validity of the laws of dilute solutions be assumed, is the potential due to hydrogen ion proportional to the logarithm of the concentration of that ion, that is, the P_H value; and yet the P_H scale takes its origin in the very region (normality) in which these laws do not hold.

Is it, then, worth while to continue the use of the P_H system?

PHYSICAL CHEMISTRY.—*Reply to Wherry and Adams' article on methods of stating acidity.*[1] WM. MANSFIELD CLARK, Hygienic Laboratory.

Wherry and Adams, in their reply to my criticism of xH, have failed

[1] Received February 2, 1921. The notation used in Dr. CLARK's book is followed in this article.—*The Editors.*

to deal with several of the more serious objections very briefly noted in my book. The replies they do give concede nothing to balance of judgment in weighing argument. For instance, one can sympathize with the spirit of reform in their answer under (4); but the force in an answer of this type depends upon several factors which are not apparent when the answer is isolated. Realizing that data in several distinct branches of science have been recorded in thousands of cases since 1909 in terms of pH and that there would be great practical difficulty in establishing the acceptance of Wherry's xH scale among all these sciences, one can consider the prospect of confusion to be an unimpeachable argument against the suggested change so long as no distinct fundamental advantage is shown. Then and then only will there be found any force in answer (4).

That no very distinct advantage is set forth by Wherry and Adams should be apparent from the shifting nature of their argument. Setting out originally to simplify the scale for "the worker in the non-mathematical sciences" Wherry uses the same mathematical steps in the experimental derivation of his xH that are used in the derivation of the pH scale. He then introduces another scale, that of "specific acidities," and at once covers up those logarithmic relationships which it is of inestimable value to impress upon the student. In using this specific acidity scale he naively acknowledges the false step for he expresses series of soil acidities with the following series of numbers[2] for specific acidities:

300 100 30 10 3 1

The "worker in the non-mathematical sciences," after reading anew in Wherry and Adams' exposition of the xH scale that the specific acidity scale reveals their solution 1 to contain 2000 times as much acid (*sic*) as solution 2, will be puzzled to know why Wherry uses such a peculiar series of numbers for soil acidities.

The secret is that Wherry knows the intrinsic physical value of a logarithmic scale (pH or xH) and has spaced his specific acidities to correspond with 0.5 point on a logarithmic scale. In this way specific acidities are made to come to the defense of xH! Wherry, in his papers, has not enough confidence in the xH scale to use it.

But a discussion of this and similar matters would be hardly worth while unless the real source of our difference in point of view could be reached. I believe I find it in the answer Wherry and Adams give

[2] Proc. Acad. Nat. Sci., Philadelphia, April, 1920.

under (1). There the point of view of a theorist seems to be confused with the point of view of an experimentalist. Wherry and Adams wish to divide the acidity-alkalinity scale into two distinct regions, a region of "acidity" and a region of "alkalinity," divided from one another by the theoretical neutral point. Now the experimental indicator method of determining "reaction," while it need not necessarily be so, is still based experimentally upon hydrogen electrode measurements. The hydrogen electrode in turn gives us, according to present conceptions, an indication of hydrogen-ion concentration or activity and tells us nothing at all directly regarding the hydroxyl ion. Our two chief methods therefore are concerned only with hydrogen-ion concentrations or activities. In view of the fact that our experimental standards of concentration are somewhat indefinite it might be wise were we to express our data in terms of electrode potential differences, but we have chosen to employ pH values which are a linear function of those potential differences. In so doing we have introduced no consideration regarding hydroxyl ions. Hence the student employing pH values for any region of the scale, including that which other considerations lead us to designate as the "alkaline" region, can easily be taught the physical and experimental significance of the values.

Furthermore, since the pH scale shows no change of sign or alteration of its continuity at the "neutral point" it gives the student a correct picture of the continuity in the actual conduct of the hydrogen electrode as solutions pass this point, and a correct picture of the continuity in the acid-base system of equilibria at or on either side of a point which we take into consideration only in calculations of certain theoretical values.

Wherry and Adams are of course clear in their minds about the matter, but their remark that the pH method of statement involves the data for pure water is made in such a way that it tends to confuse experimental physical facts with theoretical considerations. When we use the dissociation constant of a base (as determined for instance by conductance methods) to fix the approximate position of its equilibria on the pH scale we introduce several theoretical implications and should be conscious of the risk. When we use the dissociation constant of a base, as determined by hydrogen electrode measurements and expressed in pH values, we can correctly use the data to fix the position of the equilibria on the pH scale but the constant so found involves additional theory when we compare it with the con-

stants found by other methods of measurement. In the translation of values from one experimental system to another the dissociation constant of water is frequently involved. But this constant Wherry introduces at the very beginning while the user of pH introduces it only in a limited number of cases and when he wishes to make theoretical calculations of the kind which the botanist (for whose benefit xH was devised) has so far not employed.

Our difference in point of view, then, if it can be traced beyond matters which the future alone will balance properly, seems to rest upon this. Wherry's xH scale presents to the student a symmetrical picture easily grasped when approached with our habitual conception of a vital distinction between acidity and alkalinity and when the derivation is not attempted. The pH scale emphasizes the experimental derivation of values and the actual continuity in the acid-base system of equilibria.

In the use of either scale there are involved difficulties in the experimental setting up of the ultimate standards and recognizing this I have taken care in my book to suggest (in Chapter XVII) that there be, tentatively at least, agreement of the same nature that fixes our scales of length and weight. But I fail to see how the difficulties which are here involved are in any way lessened for the experimenter by setting up a definition of a new reference point as Wherry has done in choosing the hydrogen-ion concentation of pure water in place of normal hydrogen-ion concentration.

Note by Wherry and Adams.

We readily concede that the 1 : 3+ : 10 series has the real disadvantage of unfamiliarity, but so does the series 1 : 1.6 : 2.5 : 4.0 : 6.3 : 10 used by Clark. Trisection of the interval between 1 and 10 would give a series, 1 : 2+ : 5− : 10, which is already familiar, in coinage, and therefore preferable.

But surely the use of specific acidities no more connotes lack of confidence in the X_H scale than the measurement of electric current in amperes implies disrespect to Volta, after whom the unit of electrical potential is named. The X_H (potential) values may well be translated into the corresponding specific acidities (quantities) whenever the experience of the readers for whom a contribution is intended makes the method of statement by quantities more readily understandable.

EDGAR T WHERRY and ELLIOT Q. ADAMS

GEOLOGY.—*Scientific by-products of applied geology.*[1] GEORGE OTIS SMITH, U. S. Geological Survey.

"By-product" is a term that suggests large-scale industrial engineering and perhaps even "big business." By-product practice carries the complex idea of waste turned into profit, of painstaking engineering converting the raw material into many products, and of persistent salesmanship that finds a market for commodities as varied as dynamite and toilet sets or hams and violin strings. Yet, except in its larger commercial aspect, by-product practice is not limited to modern times or to large corporate enterprise; conserving the incidental or the "left-over" was also a virtue of our forefathers. The giving of value to the additional or secondary products and their successful disposal with profit to all, however, seems the modern expression of old-fashioned thrift.

So, while no doubt applied geology has always paid its tithes in the form of incidental contributions to the theoretical side of the science, it is probably true that as our geologic efforts have been spread over larger fields, with greater variety of endeavor, these scientific by-products have come to represent greater values to the world of science. As a large operator in applied geology, the United States Geological Survey would be blind to its opportunity if it failed to utilize these scientific by-products, and indeed it is to be hoped that this Federal service has caught the commercial spirit at least to the extent of seeing large profits in by-products. The other type of by-products—economic results incidental to research—would make a more impressive showing; but that is another story, well worth telling under other auspices.

In the program of geologic work of the United States Geological Survey for the last decade three phases of applied geology stand out prominently—land classification, oil and gas exploration, and the study of mineral reserves both in our own and foreign countries. Each of these phases represents a task laid upon the Survey by a national need, but none of them at first glance is expected to include research into fundamental principles of the science of geology. In fact, they have all been looked upon as a levy upon the science rather than as an aid to its progress. However, it may be opportune to pause and suggest some of the valuable by-products of all this work that has absorbed so much of the activities of geologists of high scien-

[1] Presented before the Society of Economic Geologists at Chicago in December, 1920, and the Geological Society of Washington on April 13, 1921. Received April 2, 1921.

tific training and attainments. To list all these scientific by-products, however, would result in a bibliography imposing in both length and quality.

The principal beneficial influence of land classification surveys upon our science has operated through the requirement of quantitative detail and the necessary training for close observation. The geologist trained in this work has, through great travail of spirit, attained notable accuracy in field methods, which has reacted favorably upon standards of work throughout the field organization.

The results of scientific value incidental to the large expenditures of effort and money in the classification of public coal, phosphate, and oil lands have included the increased interest in stratigraphic problems and the increased attention to structural details, overlooked in broad regional studies, and to variation in sedimentation. It is not too much to say that a large part of the present knowledge of the Cretaceous and early Tertiary stratigraphy and paleontology of the West can be traced directly to the public coal-land work, broadly administered by Campbell. The Laramie question became a live issue; Stanton, Lloyd and Hares recognized and discussed new problems in the Lance of the northern area, just as Gilmore contributed to the paleontology of the southern area; Lee and others made substantial revisions of the stratigraphic column for the eastern flank of the Rocky Mountains; and far to the north, Hollick's monographic study of the Cretaceous flora of Alaska and Martin's work on the Mesozoic stratigraphy of Alaska, of which the Triassic chapter has been published, are a direct outgrowth of the coal and oil investigations. With these and many other highly scientific contributions in mind, it is not too much to credit the fifteen years devoted so largely to examination of the Nation's coal lands with an addition to our geologic knowledge of the West fully comparable with the pioneer results of the similar period of exploration over the same area forty years earlier. The new geologic map of Wyoming now ready for publication is in largest part the result of the activities directed primarily to classifying oil and coal land.

Less obvious, perhaps, have been the scientific results of the increased attention given to structure, such as the recognition and description of the Bannock overthrust by Richards and Mansfield in mapping phosphate rocks in Idaho or the interpretation of the Hart Mountain overthrust by Hewett as a by-product of his coal and oil work in Wyoming, although the discovery of this great overthrust is

to be credited to Dake. These are displacements on a large scale, but observations of structural details have formed an essential part of the general geologic descriptions by other geologists. A few petrographic contributions have also resulted, such as the discovery of the nepheline basalt on the Fort Hall Indian Reservation by Mansfield and the detailed mapping of the Leucite Hills by Schultz.

The close observation necessary in tracing coal outcrops and in valuing public lands according to the thickness and character of the coal beds has naturally led to intensive study of variation in sedimentation. Thom's work on the Lance and Fort Union sediments, in which the source of sediment deposited in flood-plain swamps is traced by means of microscopic examination, and Hewett's discovery of the persistent presence of bentonite in the Upper Cretaceous series, proving volcanic activity in four States, are important contributions to paleogeographic science—despite the bar sinister.

The observed influence of the oil and gas studies by the Federal geologists has aroused a larger interest in geophysics and in physical chemistry, an influence which shows itself for the most part only indirectly but is none the less of large profit to our science. Here again close attention to structural details is yielding theoretical contributions, but probably the most noteworthy by-product of the oil and gas work of the United States Geological Survey has been the augmented interest in the petrology of sedimentary rocks. For purposes of correlation and of interpretation of the details of "oil sand" stratigraphy, petrographic methods must be developed and used. Questions of oil genesis, accumulation, and recovery lead to theoretical problems whose solution will deepen our insight into earth processes.

The study of mineral resources stimulated by the war also yielded scientific profits, both subjective and objective. Foremost among these I would place the appreciation of the physiographic relation of manganese oxide deposits to stages of planation and of the fact that degree of rock decay depends more upon physiographic stage than upon climate; and the fact that the tracing of deposits of manganese ore in the Appalachian Valley region disclosed a planation stage that had previously received little attention.

The study of the literature of foreign mineral reserves as a part of the American problem of raw material supply has also added to our appreciation of exact statement in geologic reports. The critical reader of scientific literature may even profit by the faults of others, and our geologists who have made largest use of the reports on the

ore deposits of the world have acquired the keenest understanding of what standards are needed in geologic work, in both field and office. This intensive study of the commercial side of geology should tend to make our science more exact.

In the course of a discussion at the Baltimore meeting of the Geological Society of America, Dr. Iddings hesitated to characterize pure geology as unapplied geology, and my suggestion was that pure science is simply not-yet-applied science. I believe this descriptive definition stands the test of our experience, and a long list of economic by-products of pure geology could be cited as proof. One such example of the later application of the results of a purely scientific investigation to everyday use of large value may be mentioned here because it illustrates the final point I wish to make. Alden's glacial studies in Wisconsin, which were continued over a decade and covered about 10,000 square miles, resulted in two professional papers, one bulletin, and one geologic folio, each a contribution of high scientific and educational value. Now, an extensive and intensive program of State highway construction has given to this geologic study a value not anticipated. Measured by the commercial standards of value, Alden's glacial mapping is expected to save the State of Wisconsin in the location of road material at least two and half times what the geologic work cost the Federal Survey. The economic by-product thus more than repays the production costs, and any economist can see a large profit in the operation.

The general trend in useful geology is to call for quantitative results, and indeed exactness is more truly scientific than vagueness. Moreover, the testimony of experience is that whatever the purpose of a geologic project, if its execution is thorough-going, its methods exact, and its standards high, it will yield by-products of value. It is therefore from the best of scientific research that economic by-products are obtained and it is only from applied geology well applied that scientific by-products may be expected. The incidental is not accidental.

The personal element in geologic by-product practice is not to be overlooked in this brief résumé of the subject. Geologists differ in both their telescopic and their microscopic vision, and even more in their catholicity of interest. The field observer whose eyes are open to every type of geologic phenomena, is pre-eminently a by-product man; and whether his primary object is the examination of a dam site or the correlation of two interglacial formations, he returns with note

book and mind enriched with all that he saw, so that the by-products may eventually outvalue the answer to his original problem. Mr. Gilbert well illustrated the geologist whose researches yielded so great a wealth of products, and in his work the line between pure geology and useful geology was not marked. In that type of geology, broad in scope and accurate in detail, by-products of high value can always be expected.

ZOOLOGY.—*The steps in the evolution of animals.*[1] AUSTIN H. CLARK, U. S. National Museum.

In the following dichotomous table are included all the essential characters of all the major animal groups, showing the successive steps by which the two most specialized phyla, the Vertebrata (in heavy-faced type) and the Arthropoda (in italics), have been evolved, and at the same time the relationship to the main developmental line of all the numerous off-shoots which have proved incapable of further evolution.

This table, which is based upon the body structure of adults, assumes the evolutionary course to have run as follows:

1. The formation of a multicellular body overcame the limitation in size inseparable from the unicellular body.

2. The appearance of quadrilateral symmetry (with a right and left side and a dorsal and ventral surface) and the correlated development of a head end overcame the inefficiency of a radially symmetrical body.

3. The development of a vascular and of a respiratory system facilitated the repair of waste and led to a marked increase in bodily activity.

4. The development of a skeleton enabled the muscles to function to better advantage, leading to a more perfect coordination of muscular action and greater perfection of bodily activity.

5. The appearance of gill clefts indicated the final stage in the centralization and perfection of the previously unorganized respiratory system.

6. The development of the dorsal nerve cords led to increased nervous efficiency through the unification and concentration of the nervous system.

7. The development, in connection with the last, of a definite head, was the final step in the centralization of the nervous control of the body.

[1] Received March 9, 1921.

Unicellular
Multicellular
Radially or bilaterally symmetrical
No definite organs nor body form
With definite organs and body form
Quadrilaterally symmetrical, with a head end
No vascular, respiratory or skeletal system
Without a special food collecting mechanism
Flattened
Cylindrical
With a special ciliated food collecting apparatus
With a vascular system and a respiratory system
No true skeleton
Unsegmented
Segmented
With a skeleton
Without gill clefts
Skeleton soft
Skeleton hard
Unsegmented externally
With a tentacular food collecting mechanism
Without a special food collecting mechanism
Segmented externally
With gill clefts
Nerves ventral
With a tentacular food collecting mechanism
Without a special food collecting mechanism
Nerves Dorsal
No definite head, and a special food collecting mechanism
Food collecting apparatus internal
Food collecting apparatus tentacular and external
With a definite head

ABSTRACTS

Authors of scientific papers are requested to see that abstracts, preferably prepared and signed by themselves, are forwarded promptly to the editors. The abstracts should conform in length and general style to those appearing in this issue.

PHYSICS.—*The efflux of gases through small orifices.* EDGAR BUCKINGHAM and J. D. EDWARDS. Bur. Standards Sci. Paper **359**. Pp. 47, figs. 7. 1920.

This paper contains a theoretical discussion of the results of experiments made during an investigation of the effusion method of determining gas density. The effects on effusion of viscosity and thermal conductivity of the gas are studied, and formulas for representing these effects are developed and compared with the observed facts. A physical interpretation is thus obtained for the most striking of the apparent anomalies observed in the behavior of gases flowing through very small orifices such as are used in apparatus for determining density by effusion. The resulting agreement of the theory with the observations is exhibited graphically. It is fairly satisfactory but not perfect, and its imperfections suggest the directions in which further experiments should be made. J. D. E.

PHYSICS.—*The constants of radiation of a uniformly heated enclosure.* W. W. COBLENTZ. Bur. of Standards Sci. Paper **357**. Pp. 11. 1920.

Experimental data are given on atmospheric absorption. The paper gives also a recalculation of the coefficient of total radiation of a uniformly heated enclosure, or so-called black body, giving a value of 5.72×10^{-12}. The effect of atmospheric absorption is discussed, and the conclusion arrived at is that, if corrections are made for atmospheric absorption, the value recently obtained at Naples is close to the average value, *viz.*, 5.7. In the second part of the paper, the present status of the constant of spectral radiation is discussed. W. W. C.

PHYSICS.—*An integration method of deriving the alternating current resistance and inductance of conductors.* H. L. CURTIS. Bur. Standards Sci. Paper **374**. Pp. 35, figs. 4. 1920.

The solution of the problem was met by a process of integration. The conductor is divided into infinitesimal filaments by surfaces which coincide with the lines of flow. The magnetic field at any point is the sum of the magnetic fields of all these filaments. The counter-electromotive force in a filament is determined by the rate at which the magnetic fields of all the others cut this filament.

Formulas for the alternating current resistance and inductance of a straight cylindrical conductor were derived by the use both of real and imaginary power series. These formulas correspond exactly with the asymptotic formulas of Russell. The same method is applied to a return circuit making use of imaginary series, and formulas for the alternating current resistance and inductance are derived. Values computed by these formulas are compared with experimental results. H. L. C.

PHYSICS.—*The variation of residual induction and coercive force with magnetizing force.* R. L. SANFORD and W. L. CHENEY. Bur. Standards Sci. Paper **384**. Pp. 10, figs. 6. 1920.

This paper is a report of an investigation to ascertain whether or not analytical expressions similar to the reluctivity relationship of Kennelly correctly represent the variation of residual induction and coercive force with the maximum magnetizing force. Hysteresis measurements were made on a number of samples covering a wide range of material using magnetizing forces up to 2500 gausses. The relationships $H_m/B_r = a_1 + b_1H_m$ and $H_m/H_c = a_2 + b_2H_m$ were found to hold within the limits of the probable experimental error. W. L. C.

SPECTROSCOPY.—*Relative spectral transmission of the atmosphere.* E. KARRER and E. P. T. TYNDALL. Bur. Standards Sci. Paper **389**. Pp. 37, figs. 20. 1920.

Data on the relative spectral transmission are given, (1) for a clear atmosphere, (2) for the atmosphere of high humidity, and (3) during rains. The curves for (1) show little selectivity. Between wave-lengths 520 and 660 mμ the transmission is uniform. At 660 it begins to decrease. Also from 520 to 440 mμ it gradually and continuously decreases. The curves for the atmospheric condition of (2) and (3) are almost identical for the region from 430 to 560 mμ, the transmission increasing with the wave-length. In the region from 560 to 670 mμ the curve for the rainy atmosphere shows a maximum near 640 mμ, while that for the atmosphere of high humidity indicates two maxima, at 580 and at 650 mμ, with a miminum near 620 mμ. The decrease at 660 mμ in both cases is very similar to that noted for the clear atmosphere, and is probably to be associated with the absorption band of the oxygen of the atmosphere. E. K.

SPECTROSCOPY.—*Wave lengths longer than 5500Å in the arc spectra of seven elements.* C. C. KIESS and W. F. MEGGERS. Bur. Standards Sci. Paper **372**. Pp. 29, fig. 1. 1920.

The concave grating spectrograph of the Bureau of Standards was used to photograph the yellow, red and infra-red arc spectra of titanium, vanadium, chromium, manganese, molybdenum, tungsten and uranium. This work is a continuation of a program of standard wave-length determination and spectroscopic analysis which has as one of its objects the mapping of the spectra of chemical elements as far out into the region of long wave-lengths as modern photographic methods will permit.

The spectrograms were made on photographic plates sensitized to the long waves by bathing in solutions of dyes. Recently "made-in-America" dyes were used for many of the plates and were as effective in their photosensitizing action as the imported ones. The wave-lengths of more than 2500 spectral lines were derived from the measurement of the plates. These wave-lengths extend from the green at 5500 Å into the infra-red beyond 9700 Å. So far as known, impurity lines and spurious lines have been eliminated from the wave-length tables. Frequency differences which are suspected of being constant have been found in each of the spectra here presented. C. C. K.

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

PHILOSOPHICAL SOCIETY

841ST MEETING

The 841st meeting was held at the Cosmos Club, November 20, 1920, with President SOSMAN in the chair and 50 persons present. The program was as follows:

C. F. MARVIN: *The law of the geoidal slope and fallacies in dynamic meteorology.*

This paper presented matters of unusual interest and importance relating to what are believed to be important fundamental errors in mathematical meteorology which have almost completely eluded detection throughout the past sixty years. Within that time the faults in question have been subscribed to by many of the highest authorities on the dynamics of atmospheric motions among both popular and mathematical writers.

The question deals with a correct representation of the possible motion of the atmosphere or of any bodies on a rotating globe when the motions occur entirely without friction of any kind. This question has occupied the attention of scientists for nearly 200 years. A correct statement of the underlying dynamic principles was first arrived at about 1858 by one of our own countrymen, WILLIAM FERREL, a member of the Philosophical Society after 1872. FERREL was many years the senior and the leader of all other writers on the mathematical analysis of atmospheric motions, and it is difficult to adequately commend the originality and completeness of his studies. Notwithstanding this there appear to be certain errors in his application of the principles of his own discovery. These have since been perpetuated in many standard text-books on meteorology which call attention to the super-hurricane wind velocities required by the operation of the law of equal areas and claim that these inconceivable velocities are prevented by atmospheric friction, convection, turbulence, etc.

These conclusions are inconsistent with Ferrel's very lucid demonstration that the action of gravity upon bodies moving freely over a rotating globe is expressed in two wholly independent inertia reactions. One of these has long been known and dignified by a specific title, the law of the conservation of angular momentum. The other reaction has also long been known, but strangely enough has never been christened. The important part it plays in controlling the motions of the air has been overlooked, or ascribed to friction and turbulence. Believing these errors to have arisen and spread, at least partly, because of the lack of an appropriate name, it is proposed that the neglected principle be designated by the name of the *law of the geoidal slope.*

For a globe rotating from the west to the east the law may be stated to be: *A geoidal surface is a neutral or horizontal surface only for bodies at rest upon it. That is, gravity is powerless to set up any lateral motions among such bodies. The surface slopes towards the equator for every body having a relative motion eastward and towards the pole for every body with a motion westward. A component of the force of gravity pulls the moving bodies down the slopes.*

Without giving a specific name to the tangential pull of gravity down the slopes, Ferrel nevertheless clearly showed that the *resultant* of this reaction and that arising from the law of equal areas was continually at right angles to the direction of motion of bodies, therefore this deflective influence of the earth's rotation is powerless to change velocities but tends continually to change direction of motions. It was made clear in the paper that *it is the pull of gravity down the geoidal slopes*, not friction, which prevents the super-hurricane velocities exploited in the text-books.

The paper discussed briefly the equation for the steady motions of the atmosphere under balanced forces, both with and without friction, and for different types of pressure distribution. The application of these equations was shown for the case of an ideal frictionless circumpolar cyclone based on pressure charts for January conditions in the free air at an altitude of 1500 meters. The velocities for this circulation are all shown to be reasonable and moderate and are irreconcilable with the super-hurricane polar winds required by the generally accepted mathematical theories when friction is zero.

The paper was illustrated with experiments and lantern slides, and has been published in full in the *Monthly Weather Review* for October, 1920.

Discussion: The paper was discussed by Messrs. LAMBERT, BREIT, SOSMAN and KIMBALL.

W. R. BLAIR: *Weather information for operating concerns* (no abstract received).

Discussion: The second paper was discussed by Messrs. BROOKS (C.F.), MARVIN, SMITH, WHITE, SOSMAN, FERNER, KIMBALL, FRANKENFIELD, and CALVERY.

ANNUAL MEETING

The 842nd meeting and 50th annual meeting of the Society was held at the Cosmos Club December 4, 1920. President SOSMAN presided, and 25 members were present.

The report of the Secretaries showed the present active membership to be 213, with a net gain of 19 for the year. One active member of the Society, Mr. C. H. SINCLAIR, died during the year. Thirty-seven new members were elected and qualified; 5 were transferred to the active from the absent list, 17 were transferred to the absent list, 2 resigned, and 2 were dropped. During the year the Society held 16 meetings for the presentation of papers. The average attendance at these meetings was 44, and the total number of papers read was 37.

The report of the Treasurer, Mr. J. A. FLEMING, showed receipts of $1318.42. Of this amount, $639.25 was from dues, $632.67 from interest, and $46.50 from miscellaneous sources. Total 1920 maintenance expenses were $958.62. $490.90 was invested in United States Liberty Bonds. The securities held by the Society amount to $13,500. The report of the Auditing Committee, consisting of W. R. GREGG, OSCAR S. ADAMS and H. F. STIMSON, was presented by Mr. Gregg, and the reports of the Treasurer and Committee were accepted.

The report of the Tellers, H. S. ROBERTS, CHARLES R. DUVALL and S. J. MAUCHLY, was presented by Mr. Roberts. The Society proceeded with the election of officers, which resulted as follows: *President*, R. L. FARIS; *Vice-Presidents*, E. C. CRITTENDEN and WALTER P. WHITE; *Recording Secretary*, H. H. KIMBALL; *Treasurer*, JOHN A. FLEMING.

In view of his election as Vice-President, Mr. W. P. WHITE tendered his resignation as Member-at-large of the General Committee. His resignation was accepted, and members-at-large of the General Committee were elected as follows: F. B. SILSBEE and O. S. ADAMS for regular 2-year terms, and W. R. GREGG for one year, to fill the unexpired term of Mr. White.

In accordance with action of the Society at its last annual meeting, the General Committee submitted, in the form of a printed memorandum, its recommendations for changes in the by-laws of the Society. Three of these were adopted, and one was referred back to the General Committee for further consideration. The principal change was in the methods of nominating and electing officers. S. J. MAUCHLY, *Recording Secretary*

BIOLOGICAL SOCIETY

616TH MEETING

The 616th meeting was held in the lecture hall of the Cosmos Club on November 27, 1920. Prof. A. S. HITCHCOCK called the meeting to order with 46 persons present. The following were elected to membership: R. A. CUSHMAN, H. E. EWING, R. M. FOUTS, T. C. GREENE, CARL HEINRICH, W. M. MANN, H. MORRISON, W. SCHAUS, L. H. WELD, G. E. THOMPSON, T. B. WILSON, C. R. ASCHMEIER, A. L. BENNETT, N. H. BOSS, W. L. BROWN, T. HORN, J. B. REESIDE, JR., Miss G. O. VISEL, P. C. VILLANNERA, D. H. ADAMS, Miss L. ALLISON, G. L. BOWEN, T. J. BRINEER, C. T. BUCKINGHAM, Miss A. M. CHAREST, Miss E. E. CHICKERING, W. F. COAKLEY, G. W. CRESWELL, F. B. CUNNINGHAM, W. G. CUSNARD, W. DEAN, J. DEUTERMAN, Miss A. E. DREW, Miss M. E. DREW, E. S. DRUMMOND, D. L. DUPRE, E. M. ELLERSON, P. S. GAULT, W. H. GEISLER, W. A. GERSDORF, E. J. GRASS, Miss H. F. HADDEN, Miss E. M. HAMRIC, Miss DORA HANSEN, S. M. HARDING, G. S. HASTINGS, W. H. HUGHES, W. JOHNSON, J. L. MCCARTHER, F. A. MAYER, Miss A. J. MILLS, F. MOORE, R. W. MURRAY, Miss E. NATHANSON, A. D. O'DONNELL, Miss H. R. OSTROM, L. A. PASSALAEQUA, C. W. PARKER, H. W. POTTER, A. PREECE, R. B. RENCH, M. RIWCHUN, G. L. ROBERTS, A. S. RUBINO, Miss M. RUSSELL, G. P. SAVAGE, H. L. SMITH, Miss L. W. STEEVER, H. C. STRAUP, Miss LURANA VAN DOREN, L. R. WATSON, JR., S. WEINSHELLBAUM, Miss D. V. NICHOLS.

Informal communications

Dr. L. O. HOWARD referred to HUMBOLDT'S statement that mosquitoes occurred in enormous numbers on the Amazon, and Dr. BRADLEY'S statement that they occurred only in spots, and asked Dr. Bradley for comments. Dr. J. C. BRADLEY in reply said that his experiences might have been in an off season; he was, nevertheless, struck by the comparative absence of mosquitoes. On the Amazon no *Anopheles*, and no malaria; on certain tributaries some *Anopheles*, and some malaria; elsewhere only scattering mosquitoes, and no malaria; at other places no mosquitoes, yet malaria is reported. In general the distribution of mosquitoes seems to be quite local.

Dr. H. M. SMITH exhibited specimens of "unnatural history" from Peking, China—artificial lizards, scorpions, millipeds, etc., made from beads, seeds, and common materials. Dr. T. S. PALMER called attention to the special exhibit of bird drawings at the Library of Congress, some very ancient, some recent and the best of their kind. Dr. L. O. HOWARD also announced the special exhibition of insect drawings at the Corcoran Art Gallery.

Regular program

J. CHESTER BRADLEY: *Plumarius, an aberrant genus of Hymenoptera.*

In 1873 Philippi described a male hymenopterous insect under the name *Plumarius*, referred tentatively to the family Evaniidae. From that time to the present the identity and relations of this insect have been a puzzle to zoologists. In 1909 André described the genus *Konowiella*, also from the male sex only, remarking that he was unable to assign it to any family. Specimens from Argentina in the hands of Professor BRUES and the writer, evidently of *Konowiella*, brought out the probability that it is synonymous with *Plumarius*, that it is an arid region form, and nocturnal.

Entomologists in Argentina were not able to throw any light upon the time of year, habits, occurrence or identity of these insects, but in the arid foothills of the Eastern Andes near Mendoza the speaker obtained last March about 100 specimens, attracted to light, of five or six species, and later two specimens on the western side of the Andes in Peru. It is thus evident that the insects represent a numerous and not uncommon group in the Andean arid regions, and perhaps may be analogous in their economy to *Brachycistis* of our Southwestern deserts.

Subsequently, at Santiago, the speaker found in the National Museum Philippi's type of *Plumarius*, and has been able to prove the identity of *Konowiella* with that insect.

Ashmead and Szepligeti had placed *Plumarius* in different subfamilies of Braconidae, and the speaker, eleven years ago, had inclined to the belief that it represented a distinct ichneumonoid family. André believed his *Konowiella* allied with the Mutillidae, Thynnidae and Scoliidae.

With the Evaniidae and Braconidae *Plumarius* has no affinities. It is an aculeate, possessing 1-segmented trochanters, 13-segmented antennae (not more than 16-segmented, as stated by Philippi), and a distinct preaxillary incision in the hind wings, a character of many aculeates, but of no Ichneumonoidea. The hind wings are also in venation quite of the aculeate type.

Two accessory veins in the forewing appear at first sight without analogy in other wasps. A study of the forewing of *Scaptodactyla* and *Photopsis*, however, demonstrates the manner in which these veins have really arisen from the accessory spurs characteristic of many Mutillidae.

In many respects the insects resemble male ants, but lack petioles. The body characters are neither strongly dissimilar, not do they entirely agree with the Mutillidae and their allies. The genitalia are of a type not dissimilar to Myrmosidae. Cerci are present.

André was undoubtedly correct in suggesting the affinities of these insects with genera which we now place in the Myrmosidae. Yet the relation must not be considered too close. The only justifiable conclusion is to erect for these insects a new family which must take its place as related to Mutillidae and Myrmosidae.

It is to be regretted that we do not know the female, but it is undoubtedly apterous. (Author's abstract.)

This paper was discussed by L. O. HOWARD and S. A. ROHWER.

W. E. SAFFORD: *Hawaii revisited.*

The Hawaiian Islands have been visited several times by Dr. Safford. In the paper presented by him he dwelt upon the changes which have taken place in the natural and social conditions between his first visit thirty-three

years ago, when Kalakaua was King, and his last visit, when he was sent to the islands as delegate from the U. S. Department of Agriculture to the First Pan-Pacific Scientific Conference, held at Honolulu from August 2 to August 20, 1920.

During the Conference Dr. SAFFORD presented papers treating of the dissemination of plants by ocean currents, the introduction of plants in prehistoric times through human agency, and the role played by the vernacular names of economic plants as indices to the origin not only of the plants but of the people who introduced them. A number of lantern slides were shown illustrating the arts and customs and the physical appearance of the primitive inhabitants and showing the contrast of the Hawaiian Islands as first seen by the lecturer with the Territory of Hawaii of today, with its great sugar and pineapple industries, the rice-fields and water-lily ponds of the Chinese and Japanese, which have almost supplanted the taro-patches of the natives, and the magnificent modern city which has grown out of the early Honolulu, with its homely residences embowered in palms and ferns, and the grass-covered houses of the natives nestling in the valleys surrounded by taro-patches and clumps of 'awa plants from which their narcotic drink was prepared.

Slides were also shown illustrating the former lava flows on the Island of Hawaii, and the crater of Kilauea, whose activity still continues.

Dr. Safford paid a tribute to the generous hospitality received by the members of the Conference and called attention to the admirable organization of the Hawaiian Sugar Planters' Association and to the important work accomplished by the U. S. Department of Agriculture Experiment Station at Honolulu, under the management of Mr. J. M. WESTGATE.

The part of this paper relating to the flora of the Islands and the role played by economic plants introduced in prehistoric times in the daily life of the primitive Hawaiians will be published elsewhere. (Author's abstract.)

A. A. DOOLITTLE, *Recording Secretary.*

ENTOMOLOGICAL SOCIETY

334TH MEETING

The 334th meeting of the Entomological Society of Washington was held in Room 43 of the new building of the National Museum on November 4, 1920. President WALTON presided and there were present 33 members and 9 visitors. Messrs. J. C. BRIDWELL, of the Bureau of Entomology, and L. L. BUCHANAN, of the Biological Survey, were elected to membership.

Regular program

L. O. HOWARD: *A recent visit to certain European entomologists.*

This was a running account of Dr. Howard's recent visit to Europe, illustrated by many lantern slides of the entomologists whom he met and of places of entomological interest. The personal characteristics, work, and special interests of the various entomologists were discussed.

N. E. MCINDOO: *The auditory sense of the honey bee.*

Beekeepers are agreed that bees can hear, yet they cannot prove it, and critics still contend that it has never been experimentally proven that any insect can hear; nevertheless, within the last few years some good experimental results have been obtained.

The special sound-producing apparatus of the honeybee consists of the membranes lying between the axillaries at the bases of the front wings.

Muscles, lying in the thorax and attached to these axillaries, contract and relax very quickly, thereby causing the axillaries to vibrate; consequently the above membranes are caused to vibrate rapidly, thus producing the piping, teeting, or squealing noise, commonly heard when a bee is squeezed.

Up to date, five so-called auditory organs have been found. Judging from their anatomy, the pore plates, Forel flasks, pit pegs and Johnson's organ, all located in the antennae, do not seem to be well fitted to act as sound receptors; but the chordotonal organs, lying in the tibiae, seem to be better adapted for this purpose. The Johnson's organ consists of the peculiarly modified articular membrane between the second and third antennal segments, and of many sense cells whose fibers unite with peculiar knobs extending inwardly from the articular membrane. The chordotonal organs are quite complicated, resembling those in certain Orthoptera.

The sound-producing apparatus and Johnson's organ in the honeybee, and also a minor detail in the histology of the pore plates, are here described for the first time.

Notes and exhibition of specimens

Mr. AUGUST BUSCK showed specimens of the Oscophorid *Carsina quercana* Fabricius which had recently been received by him for determination from Mr. E. H. BLACKMORE, of Victoria, British Columbia. This is the first American record of this European genus and species and is an interesting addition to our list of Microlepidoptera. The species is a striking form both in structure and in color, with long thick light yellow antennae reaching beyond the tips of the yellow and purple wing. The species is common and well known in Europe; the larva feeds under a slight web on the under side of oak, beech, apple and pear. The species has hitherto been recorded only from Central and South Europe and from Asia Minor and the occurrence in British Columbia is difficult of explanation. Mr. Busck had assured himself of the identity of this European and American specimen by careful slides of the male genitalia.

During the discussion Mr. BUSCK mentioned two other Oscophorid species, *Borkhausenia pseudospretella* Stainton and *Endrosis lacteella* Schiffemuller, both common to Europe and to the West Coast of North America—in fact, both nearly cosmopolitan, but not occurring in eastern United States. Both these species are scavengers on stored seeds and refuse and are more or less domestic in their habits.

Dr. A. C. BAKER stated that certain European plants are found in restricted localities in British Columbia and not elsewhere in North America.

Mr. WM. MIDDLETON presented a note on *Adult feeding and its effect on the longevity of* Dibrachys (Pachyneuron) nigrocyaneum *Norton*. In the study of the life and seasonal history of *Diprion simile*, a recently introduced enemy of pine from Europe the advent of which species in America was noted by Mr. S. A. ROHWER in the June 1, 1916 meeting of the Society, a considerable number of a small chalcid parasite (*Pachyneuron*) *Dibrachys nigrocyaneum* Norton emerged from a quantity of cocoons in one of the general rearing cages. This parasite, which is an American species, was originally described from Connecticut where the cocoons from which it was this time reared were collected, and is recorded in *The hymenoptera of Connecticut*[1] as bred from cocoons of *Diprion abietis* and *D. simile*. The parasites were reared in the latter part of August, 1915, and *D. simile* was first discovered in this country at New Haven, Connecticut, in August, 1914.

[1] Connecticut Geol. Natural Hist. Survey, Bull. 22.

Among the experiments performed with these parasites several were conducted to obtain information on the longevity of the adults, with the following results:

Sixty-five adults were placed in vials without food, all the males dying within 3 days and the females within 8 days.

Forty adults were place in a vial with a piece of cotton soaked in sugar water; all the males died within 3 days but all the females except 1, were living on the 13th day and all were not dead until the 17th day.

This experiment would seem to indicate that either the female alone took nourishment or at least they were the only ones to benefit by food with increased length of life.

Mr. ROHWER reported for the Executive Committee that the committee had decided on the National Museum as the meeting place, at least temporarily, and asked for an expression of opinion by the members. Several members expressed themselves as pleased with the arrangement.

335TH MEETING

The 335th meeting of the Society was held December 2, 1920, in Room 43 of the new National Museum building. Vice-President GAHAN presided and there were present 36 members and 3 visitors.

The Corresponding Secretary reported that he had been advised that the collection of cavern coleoptera secured from Austrian entomologists in exchange for food parcels had been sent. The collection contains 100 species representing many interesting genera not represented in the National Museum collection. The Secretary stated that these insects are to be accessioned as a gift to the National Museum through the Entomological Society.

Dr. H. E. EWING, of the Bureau of Entomology, and Mr. C. F. W. MUESEBECK, of Cornell University, were elected to membership.

Election of Officers for 1921

The officers for 1920 were re-elected. They are as follows: *President*, W. R. WALTON; *First Vice-President*, A. B. GAHAN; *Recording Secretary*, R. A. CUSHMAN; *Editor*, A. C. BAKER; *Corresponding Secretary-Treasurer*, S. A. ROHWER; *Executive Committee*, the Honorary President, E. A. SCHWARZ, the officers, and A. L. QUAINTANCE, A. N. CAUDELL, and E. R. SASSCER; *Vice-President* to represent the Society in the Washington Academy of Sciences, S. A. ROHWER.

Regular program

E. R. SASSCER: *Quarantine work on the Mexican border.*

Mr. Sasscer prefaced his paper with some remarks concerning the early history of the Pink Bollworm in the Laguna District of Mexico, and the placement of inspectors at the main avenues of entrance along the Mexican border to prevent the entry of this insect in cotton seed concealed in freight cars and other vehicles, and in passengers' baggage. It was pointed out that at the present time the Federal Horticultural Board has twenty-four inspectors located at various ports on the Mexican border, and that fumigation houses of sufficient size to fumigate freight cars are located at Brownsville, Laredo, Eagle Pass, and El Paso. Two of these houses will accommodate from one to fifteen cars, one from one to six cars, and one from one to eight cars. At Del Rio, where there is at present no railroad connection between the United States and Mexico, a small house has been erected to fumigate wagons, automobiles, etc., requiring such treatment. He stated that steps were now

being taken to erect a fourteen-car fumigation house at Nogales, Arizona. 7,772 cars were fumigated as a condition of entry from October 1, 1919, to June 30, 1920. In addition to the fumigation houses, sterilization plants have been erected by private concerns at three of the principal ports of entry for the purpose of sterilizing, by the use of heat, corn arriving from Mexico. The arrival of corn fouled with cotton seed made it necessary to adopt this safeguard before permitting the entry of Mexican corn.

Reference was made to the inspection work conducted at the foot-bridges of the various ports, and it was indicated that living larvae of the Pink Bollworm had been intercepted on several occasions in cotton seed found in suitcases and in pillows. Other injurious insects not known to occur in the United States have been repeatedly intercepted. During the first six months of this inspection work there were no less than 1018 interceptions of contraband material. Various phases of the work on the border were illustrated with lantern slides.

Notes and exhibition of specimens

Mr. R. C. SHANNON recorded the collection by himself on Moscow Mt., Idaho, of specimens of the peculiar fly, *Ambopogon hyperboreus* Greene, originally described and hitherto known only from Alaska near the Arctic Circle.

Dr. J. M. ALDRICH discussed the use of caterpillars for food by the Pahute Indians of Mono Lake, California. The species used is found to be *Coloradia pandoria*. The eggs are deposited on the bark of pine trees in the spring and hatch in midsummer. The larvae feed on pine needles until cold weather and hibernate in the clusters of needles as small larvae. They finish feeding the following summer, pupate, and emerge the next spring. The life cycle, therefore, requires two years. The larvae are collected in very large numbers by means of trenches, placed on hot earth for about an hour, and dried in the sun. They are used in the making of soup. Other insects used as human food were cited by various members: the pupae of the dipterous genus *Ephydra*, eggs of the hemipterous genus *Corixa*, etc. Other cases of two-year life-cycles in Lepidoptera were cited by Mr. BUSCK and Mr. HEINRICH, the latter attributing it in many cases to climatic conditions. Mr. ROHWER spoke of the suspended development in a portion of the brood in certain sawflies. He cited especially *Neodiprion lecontei*, which has two periods of emergence of adults from the same batch of eggs, one period in the spring and one in the fall from eggs the previous fall, and one in fall and one in spring from eggs laid the previous spring. Mr. CAUDELL stated that certain katydids and walking-sticks have two periods of hatching. Mr. MORRISON cited the case of the Coccid genus *Margarodes* in which life-cycles of 15–17 years are known.

336TH MEETING

The 336th meeting of the Society was held January 6, 1921, in Room 43 of the new building of the National Museum. President WALTON was in the chair and there were present 32 members and 3 visitors. The Editor, Dr. A. C. BAKER, reported that the contract for the printing of the *Proceedings* for 1921 had been awarded to the McQueen Co., of Washington. As chairman of the Auditing Committee, Mr. CAUDELL reported the accounts of the treasurer correct.

The Corresponding Secretary-Treasurer, Mr. S. A. ROHWER, presented his report for 1920, the tenth year of his tenure of office, including his report as

custodian of literature. After hearing a report by Mr. ROHWER on the results of the conference between the house committee of the Cosmos Club and representatives of the scientific societies, regarding the rental of the hall at the Club, the Society voted to continue to meet at the National Museum.

As a delegate representing the Society at the dinner given by the American Association of Economic Entomologists at Chicago on December 20, 1920, President WALTON reported a very profitable and enjoyable occasion, listing the representatives of the various entomological societies of the United States and Canada.

Regular program

W. R. WALTON: *Entomological drawings and draughtsmen; their relation to the development of economic entomology in the United States.*

This was a historical account of the artists who have added so much to the value of entomological publications since the beginning of entomology in America. Especial attention was given to those who illustrated the earlier works. This paper is to be published in the *Proceedings*.

R. A. CUSHMAN, *Recording Secretary.*

SCIENTIFIC NOTES AND NEWS

The Division of Graphic Arts of the National Museum has installed an exhibit showing the materials and processes involved in the manufacture of hand-made paper. The exhibit was presented by Mr. DARD HUNTER, of Chillicothe, Ohio, one of the few makers of hand-made paper in America.

The Petrologists' Club met at the Geophysical Laboratory on April 19. Prof. W. J. MILLER, of Smith College, Prof. R. A. DALY, of Harvard University, and Drs. N. L. BOWEN and P. ESKOLA of the Geophysical Laboratory, discussed *The origin and structure of the Adirondack anorthosites.*

A Mathematics Club has been organized at the Bureau of Standards by members of the staff. Dr. F. D. MURNAGHAN addressed the Club on March 28 on *Relativity and vector analysis; modern methods in vector analysis.*

The collections in the Division of Physical Anthropology of the National Museum have been enriched by an important accession. Dr. EDWARD A. SPITZKA, formerly professor of anatomy at Jefferson Medical College, Philadelphia, and for many years a student of brain morphology, has donated to the Museum his complete collection of brains of distinguished persons.

Dr. E. Q. ADAMS, of the color laboratory of the Bureau of Chemistry, U. S. Department of Agriculture, has resigned to accept a position at the Nela Research Laboratory of the General Electric Company, Nela Park, Cleveland, Ohio.

Mr. LINCOLN ELLSWORTH, of New York City, has forwarded to the National Museum a 193-kilogram iron meteorite from Owens Valley, California.

Dr. REID HUNT, formerly of the Hygienic Laboratory, now professor of pharmacology at the Harvard Medical School, has been appointed a member of the advisory board of the Hygienic Laboratory of the Public Health Service, to succeed the late W. T. SEDGWICK.

Mr. ECTOR B. LATHAM, hydrographic and geodetic engineer with the U. S. Coast and Geodetic Survey, died on April 7, 1921, at New Orleans, where he was in charge of the Survey's local station. Mr. Latham was born in McMinn County, Tennessee, June 9, 1864. He was appointed assistant at the Survey in 1895, and had been in the service since that date, engaged in triangulation and topographic, photo-topographic, hydrographic, and magnetic work. He took part in the Survey's work in the Philippine Islands, and was with the first expedition to the Mt. St. Elias region in Alaska. He was a member of the Society of Engineers.

Mr. B. H. RAWL, assistant chief of the Bureau of Animal Industry, U. S. Department of Agriculture, has resigned, effective April 30, to take charge of the educational work of the California Central Creameries, with headquarters in San Francisco.

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